country to the north. The stones in the clay are glaciated, often of limestone, with only a small proportion of crystalline pebbles or bowlders. In the deposits of the ridges, native copper has been found: consequently the drift-carrying agent moved south-eastward down Georgian Bay, to the west end of the Oak Ridge, and probably throughout its whole length. North and east of Belleville there are many more and fragmentary ridges having a trend somewhat across that of the Oak Ridge.

The glaciation of the region adds great difficulties to the explanation of the phenomena. The striation in the Ottawa valley, from Lake Tamiscamang to the junction of the St. Lawrence, is to the south-eastward, with very rare local exceptions. On the Niagara escarpment, between Georgian Bay and Lake Ontario, from sixteen hundred down to seven hundred feet above the sea, the striæ are also to the south-east; but between these widely separated regions the surface markings of the rocks are obscured to the west and south by drift, and to the north and east are absent and rarely seen, although the crystalline rocks are commonly rounded or very rarely polished, — an absence that can only in part be accounted for by subsequent erosion. About the St. Lawrence and Lake Ontario the striations are to the south-west or west. Between the Ottawa River and Georgian Bay there is a high prominence which divided the drift-bearing currents; but north of Lake Huron the glaciation is very strongly marked, and the direction is to the south-west, with very rare local variations.

All the lobes of glaciation about the Lakes, from Superior to the Ottawa valley, radiate backwards to the broad and open, but low basin of James's (Hudson) Bay. The watershed between the Lakes and Hudson Bay, during the epoch of the formation of the drift, was several hundred feet lower than now, — which is about sixteen hundred feet at present, — as shown by the differential elevation of the beaches.

For these conflicting phenomena of the drift no explanation was offered, but rather sought for.

Some remarks upon the paper were offered by Mr. Gilbert, who had observed the slight amount of erosion in the Ottawa valley; but he thought that generalized explanations of the drift were very often contradicted when applied to special regions, and that our knowledge of the phenomena would not at present give a satisfactory explanation.

Determination of Atomic Weights.

Prof. F. W. Clarke, in a paper on the determination of atomic weights, read before the Philosophical Society at its last meeting, discussed the sources of error in such constants, both with regard to the processes of weighing and to the chemical considerations involved. He dwelt especially upon the uncertainty in the atomic weight of oxygen, which affects the atomic weights of nearly all the other elements, and urged the importance of other determinations which should not hinge upon oxygen. Prout's hypothesis, now of importance in all discussions as to the nature of the chemical elements, requires the most precise determination of atomic weights, and none of the latter are yet known with enough certainty to settle the question at issue.

Distribution of Indian Tribes in North America.

The United States Geological Survey has nearly ready for publication a map showing the distribution of the Indian tribes on this continent north of Mexico. Including the labor which Major Powell himself and his immediate assistants have expended in the collection, arrangement, and digestion of the material for this map, and that done by the Bureau of Ethnology, it will represent the work of about fifteen years, and will be one of the most important and interesting publications ever made by the Geological Survey. All of the Indians living in this country at the time of the white occupation have been divided into linguistic families, and the territory occupied by each one of these families is represented on the map by a distinctive color. The number of these families is about 60, and the number of separate tribes between 300 and 350.

One of the first and most important facts shown by this map is that the territory occupied by each linguistic family, with few exceptions, is continuous. An important deduction in relation to the habits of the Indians is drawn from this fact, — that instead of being nomadic, and wandering over the continent at will, as has been generally supposed, the Indians had fixed homes, the boundaries of which were almost as plainly marked as the dividing lines between the several States are to-day, and that their wanderings were within limited areas, rarely or never extending beyond these fixed boundaries. The Indians had their permanent villages, in which they lived for five, ten, twenty, or perhaps fifty years. At certain seasons of the year they went to the coast or to the rivers to fish, or to the forest or plains to hunt. The boundaries of the territories occupied by each family were occasionally changed by conquest. A stronger tribe or family would by war push back its weaker neighbors, and thus extend its dominion. But the territory so conquered was recognized by the vanquished, as well as by the victor, as the property of the latter. If the Indians had been nomadic, and wandered over the continent or over large portions of it, branches of the same linguistic family would have been found scattered broadcast all over the country.

Some of the few exceptions to this general rule of distribution are exceedingly interesting, and throw a light upon the unwritten and even forgotten history of some of the tribes. For instance: a little colony of the great Siouan family is found in Virginia. How it became separated, crossed the mountains, and maintained itself in the midst of another family speaking an entirely different language, suggests a very interesting topic for the study of the ethnologist. Again: all the north-western part of the continent was occupied by the Athabascan family, very peaceable Indians. But the Apaches and Navajos of New Mexico and Arizona belong to the same family, and are among the most warlike on the continent. To their surroundings and the necessity of wresting their new home from its previous occupants and holding it, as well as to the inhospitable character of the country, may not their change of character be attributed? Another little tribe of the Athabascans is found in California.

One of the most degraded families of Indians of North America is the Shoshonean, of which the Diggers are a branch. And yet, strange as it may appear, the Moquis, more advanced toward civilization than any others of the Pueblo Indians, are Shoshonean.

One exceedingly interesting feature of the map is the great number of little families that lived in California and Oregon. Some of these comprise only a few individuals, — not more than forty or fifty, — and yet their languages are entirely distinct from those spoken by the surrounding tribes. In one instance Mr. Henshaw, who has charge of the construction of the map, found in California a single man, the sole survivor of his tribe. From him enough was learned to preserve the language once spoken by his ancestors, but with his death that tongue becomes extinct.

A very curious fact in relation to the distribution of the Eskimo is that they inhabit the coast of the Arctic regions to the exclusion of other Indians, beginning on the east shore of Greenland, and following the coast-line of that island around to the point farthest north inhabited by man. Then, beginning on the coast on the mainland, they occupy narrow strips on the north shores of Hudson Bay and along the northern coast of the continent, around past Bering Strait, and down the north-west coast of the continent to Prince William's Sound. Throughout all this immense coast-line the differentiation of language is very small; so that an Eskimo from Greenland transported to Bering Strait would in a month be able to speak the language of the natives there as well as though he had been born there. In striking contrast were the numerous distinct families of Indians in the valleys of California and Oregon, whose languages are so different that they could not understand each other.

This map, when published, will be accompanied by a report and discussion of the facts it discloses, and will be a very important contribution to the science of ethnology.

HEALTH MATTERS.

Malaria.

THE subject of malaria has always been a most interesting one for the study of the physician. Until the year 1879 its origin was obscure, although various theories were advanced to account for it. Klebs and Tommasi-Crudeli, in 1879, discovered in the soil of the Roman Campagna a bacillus, to which they gave the name *bacillus malariæ*, and to which they attributed malarial disease. In 1881 Laveran, a French surgeon in Algiers, discovered

the *plasmodium malariæ*, which he found in the blood of patients suffering from malaria. The views of Laveran are to-day the most generally accepted. Councilman, Osler, and Sternberg, all American physicians, have given much attention to the subject, and, so far as we know, have in general accepted Laveran's views. Dr. M. B. James of New York recently read a paper on this subject before the New York Pathological Society, which is published in the *New York Medical Record*. He says that at present our knowledge may be summed up as follows: —

"In the blood of persons suffering from malarial disease there is a series of phenomena not yet found under any other conditions. These phenomena point to the presence of an animal parasite. The appearances that we get are one or more of the following:

"*First*, Colorless protoplasmic bodies inside the red blood-corpuscles. They vary in size from one-fifth to almost the whole diameter of the corpuscle. They exhibit active amœboid movements. Some contain scattered granules of brownish-black pigment; others are unpigmented. The red corpuscle which contains the amœboid body is commonly larger, flatter, and paler than normal.

"*Second*, We find disk-shaped bodies of colorless protoplasm. They are somewhat larger than a red blood-corpuscle. They show no amœboid movements. They contain scattered pigment-granules. They are apparently a later stage of the form first mentioned, which has come to occupy the entire corpuscle, and has then entered upon a cyst stage.

"*Third*, We find forms similar to the cysts, but in which the pigment-granules have become massed at the centre, while the protoplasm is undergoing segmentation. Then there are found various stages in the transition from the encysted to the segmentary form.

"*Fourth*, We have the small masses of protoplasm that have resulted from the segmentation of the cyst form. They are commonly somewhat oval in shape. In fresh blood it is difficult or impossible to distinguish them from blood-plaques. In dried blood they show a tolerably characteristic bipolar staining with aniline dyes.

"*Fifth*, We have hyaline bodies of crescentic shape, in length rather more than the diameter of a red blood-cell. They have, in every case, a collection of pigment-granules in their centre. These are the so-called 'crescentic bodies.'

"In some cases there are found bodies resembling the crescents closely in character, but elliptical or round. The crescents may have a delicate curved outline opposite the concavity or convexity, or both, but this outline never reaches quite to the tips of the crescent.

"Lastly, there are the various motile bodies. These are, first, flagellated bodies, — a round or pear-shaped body, about one-half the diameter of a red blood-cell. It contains pigment-granules, and is provided with from one to four flagella, which show an active lashing motion, and by means of which the organism moves about in the blood-plasma. The flagella are several times as long as the diameter of a red cell. Their motion is active enough to set up well-marked movements on the part of the neighboring blood-corpuscles. Second, free flagella have been described. They seem to have become detached from their bodies, and to be capable of leading an independent existence. They exhibit active movements. Third, some observers have described hyaline pigmented bodies with an actively moving, undulating periphery."

In thirty-five cases in which Dr. James had an opportunity of studying the blood, he found the parasite in thirty-four. In one case, in which he was able to examine the blood but once, he failed to find it. In several cases where the diagnosis was doubtful he has been able to exclude malaria by failing to find the plasmodium, and the subsequent history has confirmed the microscopic examination.

The microscopic technique is simple. The blood is best examined fresh, spread out in the thinnest possible layer, — the rouleaux of corpuscles broken up. High-power objectives are necessary. A $\frac{1}{12}$-inch oil immersion answers well.

Stained specimens are best prepared by drying the blood in a very thin layer on a cover-glass, which is then passed through a flame, as in examining for bacteria. It may be stained in a watery solution of an aniline dye, washed out in water, or partly decolorized in alcohol, and mounted, as usual, in balsam. Fuchsine and methylene blue give the best results. Dr. James finds methylene blue most satisfactory, the red corpuscles staining light green, and the hæmatozoa blue.

Unpigmented amœboid bodies are best studied in stained specimens. The pigmented amœboid bodies, which are those most commonly met with, are best seen in fresh blood. The crescents also show most satisfactorily unstained. The segmenting bodies and free spores are best studied after drying and staining.

The apparent effect of medication on the organism is important. A few large doses of quinine are almost invariably followed by a disappearance from the blood of the various amœboid forms. The crescentic bodies remain unchanged after quinine, but commonly show a diminution in number as the health improves under the treatment proper for chronic paludism.

These apparent results of treatment followed in his cases as in those of most other observers. The organism has not yet been discovered except in human blood and organs. It has never been isolated. It has never been cultivated outside the body.

Inoculative experiments on human beings are almost uniformly successful. Intravenous injection of malarial blood into a healthy individual is followed by typical intermittent fever, with the appearance in the blood of the second person of the various forms of the organism described. These experiments have been made by Gerhardt in Germany, and by Marchiafava and Celli and other Italians.

Subcutaneous injections have been unsuccessful.

The few inoculative experiments that have been made upon monkeys have been unsuccessful.

As regards the name of the organism: the term 'plasmodium has been improperly used in this connection. This name has long been applied to a segregation stage of some of the mycetozoa, and so means, not a particular organism, but a stage of development common to many different organisms. Moreover, so far as we know, the malarial germ has no plasmodium stage.

It is much better, then, in designating the malarial organism, to use the term 'hæmatozoon of malaria,' as suggested by Laveran, which commits us to no definite classification.

TYPHOID INFECTION. — The investigation into the outbreak of typhoid-fever at the Michigan State Prison at Jackson by Prof. V. C. Vaughan has resulted in obtaining facts which tend strongly to prove that the outbreak was due to defective sewerage. We have repeatedly maintained in *Science* the probability that sewers and house-draining were efficient agents in the propagation of typhoid-fever, basing our opinion upon a large number of cases which occurred in Brooklyn in 1885, in which all other sources seemed to be excluded. In the investigation which Professor Vaughan made, the water-supply and milk-supply were first ruled out as possible vehicles by negative evidence. It was then thought that the defective condition of the sewers, combined with the insufficient supply of fresh air, was the most probable cause of the epidemic. The cases nearly all were from a distinct portion of the prison, and investigation proved that the soil-pipe running from the hospital, and the house-drain, into which it entered, were defective, and were pouring sewer-air into that portion of the prison. Professor Vaughan took to his laboratory a sample of the air from within the soil-pipe, and has found within it the specific germ of typhoid-fever. Such facts as these are of the greatest practical importance, and should be made a matter of record whenever they are observed, and should be widely disseminated. They show the absolute necessity for thorough disinfection of the excreta of typhoid-fever patients, and the dangers which may and probably will result from a neglect of this important measure. Had the discharges from a single typhoid-fever patient been efficiently disinfected, the devastating Plymouth epidemic, which resulted in the sickness of 1,153 persons, and the death of 114, and a total money-loss of $115,539, would never have occurred.

GRAFTS ON WOUNDS. — Dr. Redard has communicated to the Académie de Médecine of Paris, according to the *New York Medical Record*, some observations regarding animal grafts on wounds in human beings. In a case of severe burn of the scalp, of eight

months' standing, in a child two years of age, he obtained a rapid cicatrization by means of grafts from a fowl. He first tried grafts of frogs' skin, but as these proved to be repulsive to patients, and did not give very good results, he substituted others from the fowl; and the wound, which measured three inches by two and a half, had completely healed in two months. He had been equally successful in other and subsequent cases. He takes the skin from beneath the wing of a chicken, carefully securing the subjacent cellular tissue, but avoiding adipose tissue. The transplanted pieces varied from a sixth to a third of an inch in size, and they were maintained in position by means of a little cotton-wool and iodoform gauze. The skin of birds and fowls has the advantage of being supple, delicate, and vascular: it adapts itself readily to the surface of the wound, and adheres without undergoing absorption.

THE HUMAN BREATH. — Professor Brown-Séquard has recently been making experiments to determine whether the human breath was capable of producing any poisonous effects. From the condensed watery vapor of the expired air, he obtained a poisonous liquid, which, when injected under the skin of rabbits, produced almost immediate death. He ascertained that this poison was an alkaloid, and not a microbe. The rabbits thus injected died without convulsions, the heart and large blood-vessels being engorged with blood. Brown-Séquard considers it fully proved that the expired air, both of man and animals, contains a volatile poisonous principle which is much more deleterious than carbonic acid.

ELECTRICAL SCIENCE.

Electrical Traction.

IN the last two or three years a number of street-car lines have been equipped with electric motors, and most of them have been successful in spite of the inexperience of those who have done the work, — an inexperience due to the newness of the field. The number of electric railroads under way is increasing rapidly, and for certain classes of work the motor seems destined to take the place of the expensive and overworked car-horse.

As yet the greater part of the lines equipped have been for city tramways, generally in the suburbs, where there is comparatively little street traffic. This, however, is only a beginning, more useful in the experience it gives, and in the problems that are brought up and solved, than in the absolute results: for the question of the application of electricity to traction is a very broad one, and does not stop at street-railways. The elevated railroads may be run by electric motors; already motor cars are used in mines, where there is an extended field for their use; and it is possible that a few years will displace the steam locomotive, and substitute in its place powerful electrical locomotives.

There is no apparatus for the transformation of energy that compares in simplicity and efficiency with the dynamo-electric machine and electric motor. The steam-engine transforms perhaps fifteen per cent of the energy of coal into mechanical work; while the efficiency of a good dynamo may be ninety-two per cent, and a motor may have as high an efficiency. If, therefore, we transform mechanical work into electrical energy by a dynamo, and retransform it to mechanical work again by a motor, we have a total loss of perhaps fifteen per cent. It may be easily shown that in many cases it would be profitable, by taking advantage of the higher efficiency of large-power plants, and the comparatively small cost of attendance, repairs, etc., per horse-power, to generate all the mechanical energy needed in a district at some central station, and distribute it by dynamos and motors to the consumers, displacing the small steam or gas engine plants previously used.

For traction-work the problem is not to replace stationary steam-engines or gas-engines, but to replace horses, cables, and locomotives. This problem is being attacked, and will doubtless be at least partially solved.

Before taking up the relative merits and cost of different systems, let us consider the broad questions that are involved. The questions are, (1) How can we best produce the electrical energy needed? (2) How can we best get it to our motors? and (3) After we get it there, what is the best way to apply it to traction?

Under the first head there are a good many things to consider, and many of these can only be answered by knowing the exact conditions of our installation. We can say generally that for a given horse-power needed at our motor we should so choose our source of power and location of generating-station that the interest on first cost of plant and conductors (supposing we use them), the total depreciation, and the cost of the power *generated*, should be a minimum.

We will discuss these questions more fully when we come to the question of cost. To show the nature of the problem that might arise, suppose we have a railroad line from Philadelphia to New York to be run by electric motors. We would possibly find it best to have a number of generating-stations along the line, at distances apart of, say, twenty miles. Now, if there were no natural sources of power near the tracks, we would have to calculate the best distances apart for these stations, knowing the cost for a horse-power with plants of different sizes, the cost of copper for conductors, the cost of a ton of coal at different points on the line, etc. The problem would not be a difficult one. If, however, there was at some distance from the line a source of natural power, — a waterfall, for example, — we would have to redistribute our stations, and calculate whether it would cost less or more to utilize the waterfall, decreasing the cost of power, in that we do not have to pay for coal, but increasing the size of plant for a given electrical energy at the line (for we must supply the needed energy *plus* the loss on our lines), and increasing the outlay in conductors. Of course, this is all a very definite question, presenting little difficulty to the electrical economist. When we consider that some railroad lines have distributed near them water-power capable of running all of their trains, with help at long intervals from steam-generating stations (even windmills are not to be despised in some cases), and when we further consider that the conditions are much simpler than in city traffic (we can use high potentials and unsightly devices if we choose), it encourages one to predict a future for electric railroads.

If, as I have so far assumed, we are going to transmit the electrical energy to the motors by conductors, it is evident that the potential we can use comes in as a factor. In cities we are usually limited to a comparatively low potential, — a maximum, say, of five hundred volts. This has the effect of locating our generating-station as near the line as possible, — in the middle of the line if we can get it there, — for the cost of conductors would be great if the station were too far from the line. We will have more to say on this in any early number.

ELECTRICAL TREATMENT OF SEWAGE. — Mr. William Webster, F.C.S., has patented a process of purifying sewage by means of the electrical current. The pollution of rivers by the sewage of large cities is a constant source of danger to health; and, according to the London *Standard*, £1,000,000 is to be spent in attempting, by the employment of chemicals, to purify the London sewage. Mr. Webster's plan consists in sending a current of electricity from metallic electrodes through the sewage. The result, in experiments made on a very small scale, is to set the solid particles held in suspension in motion, "a kind of procession taking place from the top downwards, and from the bottom upwards. The sum-total of the movements consists in landing the suspended particles at the top of the liquid." "So prompt is the effect of the electric current that in twenty minutes a volume of opaque sewage becomes perfectly transparent, except at the top, where the organic matter collects in a semi-solid form." "From results already obtained it is calculated that the cost of the electrical treatment of the London sewage would be about £25,000 per annum. The annual outlay for chemicals is expected to be £18,000 for lime and iron, and £12,000 for permanganic acid, making a total of £30,000, a balance of £5,000 in favor of the electrical method. It would seem that Mr. Webster's experiments have, as yet, been on a small scale. If the practical results bear out what has been done in the laboratory, the process will be of the greatest importance.

TRANSFORMERS. — Two papers on this subject, read before the Society of Telegraph Engineers and Electricians, — one by Mr. Kapp, the other by Mr. Mackenzie, — have excited considerable discussion and interest on this subject of commercial induction-coils. Mr. Kapp's paper treats of the relative merits of different forms of transformers, and his methods are simple and easy of